



Photo: Jesse Abrams, Rio Grand National Forest

# Integrating Social and Ecological Resilience into Forest Management Planning

Final Report: JFSP Project Number 16-3-01-10

Project website: <http://ewp.uoregon.edu/ForestResilience>

This report written and compiled by: Dr. Heidi Huber-Stearns and Autumn Ellison, University of Oregon.

## Principal Investigators:

Dr. Heidi Huber-Stearns, Director, Ecosystem Workforce Program and Institute for a Sustainable Environment, University of Oregon, 5246 University of Oregon, Eugene, OR 97403. Phone: (541)346-0675. Email: [hhuber@uoregon.edu](mailto:hhuber@uoregon.edu).

Dr. Jesse Abrams, Assistant Professor of Natural Resource Policy and Sustainability Warnell School of Forestry and Natural Resources, Savannah River Ecology Laboratory, University of Georgia. Email: [jesse.abrams@uga.edu](mailto:jesse.abrams@uga.edu).

Dr. Courtney Schultz, Associate Professor of Forest & Natural Resource Policy; Director of the Public Lands Policy Group at CSU Department of Forest and Rangeland Stewardship, Colorado State University. Email: [courtney.schultz@colostate.edu](mailto:courtney.schultz@colostate.edu).

Dr. Alexander Evans, Executive Director, The Forest Stewards Guild. Email: [zander@forestguild.org](mailto:zander@forestguild.org).

## Co-PI:

Dr. Cassandra Moseley, Interim Vice President for Research and Innovation, University of Oregon.

## Other collaborators

Dr. Michael R. Coughlan (Research Associate) and Autumn Ellison (Research Assistant); Ecosystem Workforce Program, Institute for a Sustainable Environment, University of Oregon.

Dr. María Fernandez-Gimenez, Professor, CSU Department of Forest and Rangeland Stewardship, Colorado State University.

## Graduate Research Fellows:

James Chapin, University of Georgia

Thomas Timberlake and Michelle Greiner, Colorado State University

## Students Assistants:

Alison Deak; Ecosystem Workforce Program, Institute for a Sustainable Environment, University of Oregon



This research was funded by the Joint Fire Science Program.  
For further information: [www.firescience.gov](http://www.firescience.gov).

## INSTITUTE FOR A SUSTAINABLE ENVIRONMENT

5247 University of Oregon

Eugene OR 97403-5247

T 541-346-4545 F 541-346-2040

[ewp@uoregon.edu](mailto:ewp@uoregon.edu) • [ewp.uoregon.edu](http://ewp.uoregon.edu)



## I. Abstract

The emergence of resilience as a guiding concept for land management represents the culmination of a decades-long paradigm shift on the part of resource managers and conservation scientists. In contrast to the steady-state, output-oriented planning approaches dominant throughout much of the twentieth century, the resilience approach recognizes social and ecological systems as dynamically linked, multiscalar, and subject to thresholds of change beyond which reversal is difficult or impossible (Walker and Salt 2006). The restoration of resilient landscapes has been emphasized in multiple key land management policies, directives, and mandates over the last decade (Bone et al. in review; Hamilton 2015). While these policies collectively promote resilient landscape outcomes, it is unclear to what extent forest planning institutions are prepared to accommodate a transition from the linear approaches of the past to embrace the core components of a resilience-oriented approach.

This project sought to 1) analyze the current state of resilience conceptualization in USDA Forest Service (USFS) planning and management, 2) identify opportunities and barriers to resilience planning in an effort to inform future practice, and 3) Develop and disseminate resources to help fire, fuels, and forest planners and managers better incorporate resilience approaches with planning processes at multiple scales. Each of these project objectives were met through an approach including policy review, content analysis of U.S. Forest Service environmental impact statements, case studies of three national forests with recently revised forest plans, and a national survey of national forest planners and managers.

Resilience is a complex and far-ranging concept and there has been controversy as to its exact meaning, which was supported with our research findings. Our research found that USFS planners and managers were not always consistent or clear in their resilience terminology and many USFS employees felt that the agency's use of the term was unclear. We also identified opportunities and challenges around the definitions and conceptualizations of resilience, instituting adaptive and flexible management, capacity issues in managing for resilient landscapes, constraining and enabling policies and practices for resilience, and broader political and institutional considerations. Through all stages of this research we gathered information to help create summary documents, resources and other information to help fire, fuels, and forest planners incorporate resilience into planning processes at multiple scales. We propose suggestions for how to plan for resilience, with an emphasis on partnerships drawing on scientists, managers across different agencies, and local communities, and breaking up resilience planning into specific steps or phases makes the challenge less daunting and more understandable.

This research created resources for land managers, and contributes to the limited literature on how resilience is incorporated within the agency planning processes. Our research demonstrates how USFS planners and managers are attempting to incorporate the ambiguous concept of resilience into a complex managerial and policy context which is riddled with potentially contradictory pressures and expectations. National forest managers perceive resilience as a concept and disturbance agents differently across the National Forest System, which is not surprising and is broadly aligned with prior scholarship on the topic. However, we also identified novel dimensions of resilience-oriented forest management related to the influence of policies, pressures, and agency priorities.

Our results also suggest that the current policy mix and leadership direction at different scales might not be well structured to support management of national forestlands for resilience. A promising avenue for addressing some of these challenges and achieving resilient outcomes are policies that help planners and managers engage in collaboration, use newer optional tools in planning, build partnerships, and incorporate high-quality scientific information, all of which will require continued political and budgetary support (Coughlan et al., 2020). We also note some areas for future research.

## II. Objectives

The objectives of this project were as follows:

Objective 1. **Analyze the current state of resilience conceptualization and adoption in USFS planning and management.**

Objective 2. **Identify the opportunities and institutional barriers to resilience planning and conduct a needs assessment to inform future practice**

Objective 3. **Develop and disseminate resources to help fire, fuels, and forest planners incorporate resilience into planning processes at multiple scales.**

### Relation to the task statement and :

This project sought to respond to the task statement's call for ***research that advances the conceptualization and achievement of resilient landscapes*** by analyzing the alignment of resilience mandates with the operational context of USFS planning and management. This project built on previous work by the project team around the use of resilience within forest planning by conducting an institutional analysis and needs assessment of USFS staff.

Each of the original objectives for this project were met. Specifically, through an approach that included policy review, content analysis of Economic Impact Statements, a survey of USFS staff involved in interdisciplinary planning efforts, and case studies of national forests that recently revised their forest plans, the project contributed to an understanding of how organizations adapt in response to new mandates and challenges. It also provides insight on how managers and planners may constructively reconcile a resilience approach with existing institutionalized planning frameworks. Each of the deliverables created for this project offer additional and extensive detail on these stated objectives.

## III. Background

In contrast to the steady-state, output-oriented planning approaches dominant throughout much of the twentieth century, the resilience approach recognizes social and ecological systems as dynamically linked, multiscalar, and subject to thresholds of change beyond which reversal is difficult or impossible (Walker and Salt 2006). This is a clear departure from the planning paradigm that has guided federal land management for decades. This shift has been motivated by acknowledgment of climate change impacts and by the growing extent and severity of wildfire on and near public lands. Restoring resilient landscapes is emphasized in the 2016 U.S. Forest Service (USFS) proposed budget, the 2012 National Forest Management Act (NFMA) planning rule, Forest Service Manual Directive 2020, and the Cohesive Strategy, as well as in other policy directives and mandates (Bone et al. in review; Hamilton 2015).

While these policies collectively promote resilient landscape outcomes, in many instances it remains unclear to what extent forest planning institutions are prepared to accommodate a transition from the linear approaches of the past to a resilience-oriented approach. The resilience paradigm's focus on adaptation, nonlinearity, and uncertainty can appear to stand in contrast to prevailing laws and policies (formal institutions) as well as the culture, training, and institutionalized procedures (informal institutions) that guide forest planning in practice (Benson and Garmestani 2011). For example, the requirements of the National Environmental Policy Act (NEPA) and associated procedures emphasize the

prediction and disclosure of impacts and pose barriers to adaptation once a decision has been reached, rather than allowing for managerial flexibility as site-specific information is gained.

This research project suggested that a broader process of institutional change within federal land management agencies may be necessary for resilience policy to be implemented successfully in practice. Further, it aimed to contribute to this change by investigating how resilience has been incorporated into forest planning to date, what institutional barriers impede a successful transition to resilience-oriented planning, and what resources and innovations stand to benefit planners and managers in making this transition. Despite the relative novelty of resilience-oriented concepts and the persistence of conventional planning institutions, forest planning efforts at the time of this project's proposal demonstrated that planners were beginning to engage with the implications of a resilience approach and innovate in pursuit of resilient landscape outcomes. This provided a unique opportunity for our research to help illuminate the current state of resilience resources, practices, institutional barriers, and potential innovations to help disseminate best practices and inform the continued improvement of resilience planning and management. To maximize on this opportunity, our research included a combination of document analysis, case studies on national forests with recent forest plan revisions that had incorporated resilience concepts, and a survey of Forest Service planners. This approach allowed us to integrate the collective expertise of USFS managers and planners with policy and institutional research to provide a comprehensive analysis of the current state and trajectory of resilience planning within the agency. In our project deliverables, we focused on the development of practical resources that could help advance forest planning for resilient landscapes and that were relevant for managers, stakeholders, policymakers, and researchers.

#### **Scientific relevance:**

This work addresses the question of how planners and managers within a large, complex agency adapt to novel social and ecological challenges in response to new policy direction (Moseley and Charnley 2014). More than simply a new terminology, the resilience approach emphasizes uncertainty, nonlinearity, adaptability, consideration of cross-scale linkages, and the conceptualization of human and natural systems as linked systems rather than as separate fields (Walker and Salt 2006). The resilience literature stresses the importance of institutions as prime determinants of adaptive (or maladaptive) individual and organizational behavior; institutions associated with the federal land management agencies have been identified as key drivers of wildfire management specifically (Abrams et al. 2015). Scholars have identified formal institutions (such as laws, policies, and regulations) as both constraints on and potential resources for furthering resilient resource management (Green et al. 2015). Benson and Garmestani (2011, p 395), for example, conclude that, "while managers might want to embrace resilience on a conceptual level, management directives will inevitably default to the core statutory and regulatory requirements."

Although researchers find that policy redesign can promote increased capacity for monitoring, adaptive management, and integrated planning across resource areas, these policy initiatives may require significant changes to informal practices and procedures to be successful (Schultz and Nie 2012). A wide variety of tools have been created to help practitioners think about and plan for resilience. However, to date little work has addressed either the incorporation of such tools into agency planning processes or the challenges to planning for resilience more broadly. This project addressed this gap by analyzing institutional challenges to resilience planning and identifying points of intersection between resilience concepts and NEPA-driven planning processes to help managers put resilience concepts into practice. This research also illuminated current processes of institutional adaptation in the USFS and pointed toward additional steps needed to more fully incorporate resilience within planning practice.

## IV. Materials and Methods

This study used a mixed-methods research approach that included three distinct elements:

1. A content analysis of Environmental Impact Statements (EIS);
2. A survey of USFS staff that have been involved in interdisciplinary planning efforts
3. Case studies of three national forests that have recently revised their forest plans

This research design allowed us to integrate the collective expertise of USFS managers and planners with policy and institutional research to provide a more comprehensive analysis of the current state and trajectory of resilience planning. The following sections provide a brief overview of the methods used in each of these approaches in this project:

### **1. A content analysis of Environmental Impact Statements (EIS)**

The content analysis of EIS statements included documents created since 2011 that included the terms “resilience” or “resilient” to determine how the concept of resilience has been defined and integrated into planning documents. This analysis built upon prior work involving the project team that focused on analyzing “resilient landscapes” in USFS documents (Bone et al., add date). In short, each EIS component was analyzed according to the type of resilience that was implicitly or explicitly applied, and each document was coded for a list of attributes to a) determine trends in resilience conceptualization and management over time and b) identify persistent gaps in resilience planning. Complete methods are outlined in a forthcoming journal article (Chapin et al., in review).

### **2. Survey of USFS staff involved in interdisciplinary planning efforts**

We manually created a contact list of Forest Service planners from all (over 1,200) Environmental Impact Statements from all national forests from 2013-2020, resulting in over 2,200 contacts that we invited to participate in an online survey. All responses were anonymous. The survey asked planners about definitions of resilience, the influence of disturbance agents on resilience of forests, the influence of policies and practices within the Forest Service on resilience, and leadership priorities and agency objectives. We sent reminders to each contact before closing the survey and analyzing responses. Complete methods are outlined in a forthcoming journal article (Coughlan et al., in review). The specific objectives of the survey were to:

1. Understand land manager experiences with resilience as a concept and as an element of national forest policy;
2. Recognize how agency policies and practices can influence the ability of units to manage for resilience;
3. Identify how land managers perceive the relative importance of different agency objectives at forest, regional, and national levels.

We received 608 responses, of which 428 were ultimately determined to be fully completed. This included survey respondents based in all nine Forest Service regions and at the Washington Office level, with between 15 (Region 9) and 77 (Region 6) respondents per region (see Figure 1, below). Respondents had between 1 and 52 years of experience working for the Forest Service, most commonly working: at the forest (45%) and district (36%) level, in the National Forest System, and at GS levels 11 and 12 (Coughlan et al., 2020). The most commonly selected focus area for respondents’ positions was planning and NEPA, followed by wildlife and fish (16%) and silviculture/timber (13%).



**Figure 1 Forest Service regions and the number of survey respondents from each region**

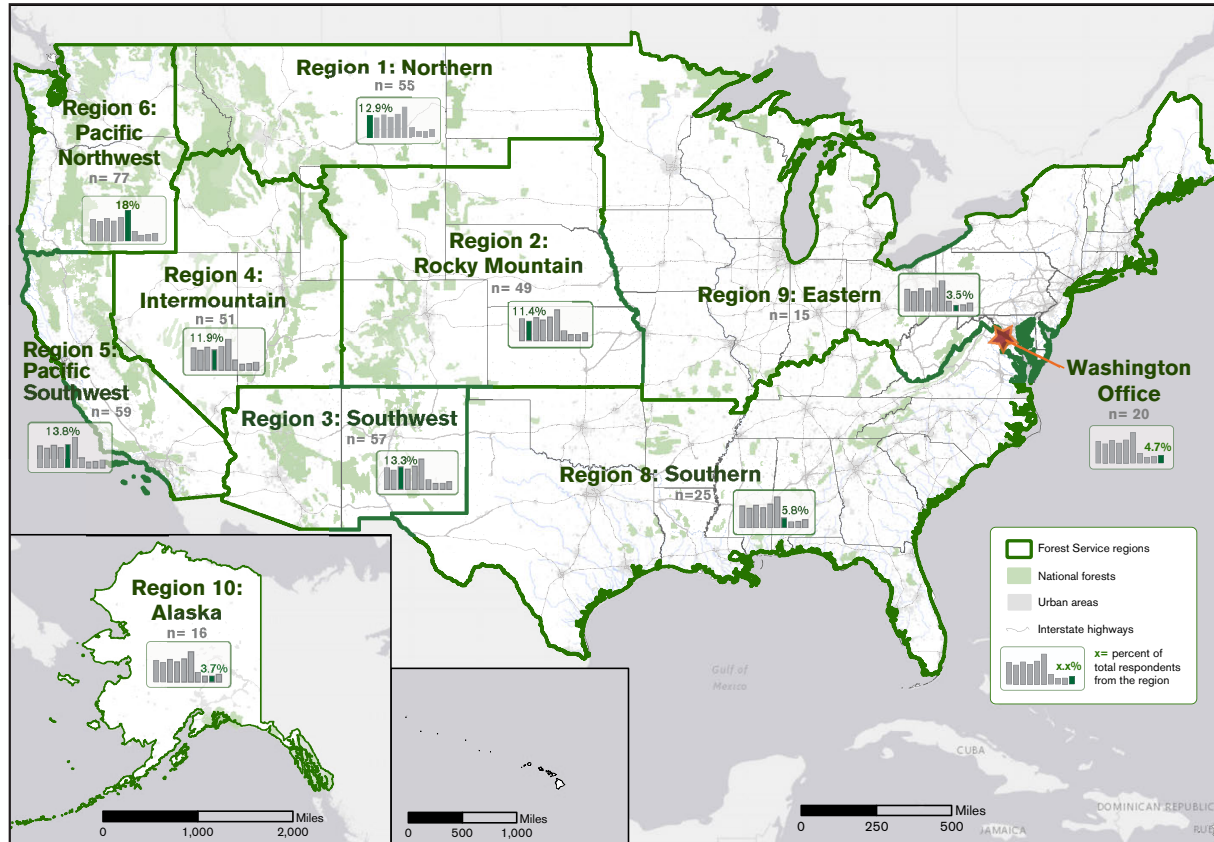


Figure 1 from Coughlan et al., 2020

### 3. Case studies of national forests that have recently revised their forest plans

We purposefully selected three national forests that recently completed forest plan revisions and addressed resilience in the context of fire and climate change. Case studies included the Francis Marion National Forest in South Carolina, the Kaibab National Forest in Arizona, and the Rio Grande National Forest in Colorado. The Francis Marion and Rio Grande National Forests used the 2012 Planning Rule to guide their revisions; the Kaibab National Forest used an earlier version of the Planning Rule but nevertheless made a conscientious effort to integrate concepts of resilience, ecological integrity, and consideration of climate effects. For each case we reviewed relevant documents related to the recent plan revision and reached out to key informants actively involved in national forest planning. Between 2017 and 2019 we interviewed a total of 64 individuals across all cases. Interviewees included U.S. Forest Service line officers, planners, and other staff at both the national forest and regional office levels, as well as non-Forest Service stakeholders who participated in some way in national forest planning or management. We analyzed interview data using qualitative analysis software. Complete methods are outlined in a forthcoming journal article (Abrams et al., in review).

## V. Results and Discussion

The findings addressed below represent some of the main findings from this research project, organized by research objective. These findings are addressed only briefly here. In-depth findings and discussion

can be found in EWP Working Papers #77, #100, and #101, the “Incorporating Resilience Quick Guide,” and Briefing Paper #s 87 and 88; all of which can be found on the project website at <http://ewp.uoregon.edu/ForestResilience>. Findings are further elucidated in two published manuscripts and three manuscripts that are under review at academic journals. All publications noted above are included at the end of this document. All figures and tables included are labeled with their location within the existing publications, for ease of reference.

### **Objective 1. Current state of resilience conceptualization and adoption in USFS planning and management.**

Resilience is a complex and far-ranging concept and there has been controversy as to its exact meaning. Our research found that USFS planners and managers were not always consistent or clear in their terminology and that many USFS employees felt that the agency’s use of the term was unclear. For example, our review of Environmental Impact Statement (EIS) documents found that of the documents that discussed resilience, only 30% included an explicit definition of the term. Common types and definitions of resilience are noted in Table 2 below. Our review of EIS documents and survey found that, like prior research has noted, to date, ecological resilience has been the form used most often in federal agency planning. Various agency policies mandate or encourage the use of resilience in planning. For example, various strategic documents from the U.S. Forest Service emphasize resilience as a key element of climate change adaptation, and ecological integrity is central to the U.S. Forest Service’s land management planning regulations promulgated in 2012. Accordingly, many planning units working on revising their land management plans are using the concept. Our resilience review also found that the concept also plays a central role in the National Cohesive Wildland Fire Management Strategy, and with how agencies employ adaptation efforts and responding to disturbances, including the Natural Resources Conservation Service, the Bureau of Land Management, and the National Park Service, all of which are employing adaptation efforts and approaches to responding to disturbances (Timberlake et al., 2017).

**Table 2 What is resilience? The following three conceptualizations are most common among scholars (Timberlake et al., 2017)**

<b>Resilience conceptualization</b>	<b>Definition</b>
Engineering Resilience	The speed and ease with which a system returns to its equilibrium state following a disturbance (Holling, 1973).
Ecological or Social Resilience	“The capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks” (Walker et al., 2004, 2).
Social-Ecological Resilience	The capacity of an integrated social-ecological system to constructively incorporate and deal with disturbance in ways that do not lead to drastic social consequences (Folke, 2006).

We also found a variety of ways in which recent national forest plans were employing the use of resilience, providing specific examples as a new contribution to existing limited literature on this topic. Textbox 2 (from Abrams et al., 2020) shows several examples of the use of resilience in recent national forest plans, which are mainly grounded in ecological resilience. Our research also found that agency understandings of resilience focused nearly entirely on nonhuman systems, with human uses and land uses often acknowledged but treated separately from discussions of resilience and restoration.

## Textbox 2: Examples of the use of resilience in recent national forest plans

- “The composition, structure, and function of vegetative conditions [for a pinyon-juniper woodland] are resilient to the frequency, extent and severity of disturbances (such as insects, diseases, and fire), and climate variability” (Cibola National Forest 2016, 40).
- “Terrestrial habitats as measured by vegetation structure, density, and species composition are resilient to damaging insects and pathogens” (Chugach National Forest 2015, 19).
- “Culverts and other passage improvements are to be designed to restore and maintain hydrologic and aquatic habitat function and stream channel resiliency to a range of flows through natural channel design and other acceptable treatment measures” (Colville National Forest 2016, 46).
- “The Forest resources and operational management are resilient to the influences of a changing climate. Management activities reduce the susceptibility of resources to multiple threats, including drought, invasive species, disease, and wildfire. The immediate and long-term resilience of the Forest will be changed by:
  - Responding to changes in visitor behavior and mitigating any seasonal increases in use;
  - Enhancing landscape connectivity by maintaining natural migration corridors between lowland and upland forests to allow species to move up-slope into cooler environments as climate warms;
  - Maintaining piles of natural woody debris and promote wetlands and ponds in areas of high amphibian diversity to supplement habitats that retain cool, moist conditions; and
  - Rapidly detecting and eradicating invasive species introductions and new locations, especially following disturbances from hurricane events in high-elevation communities” (El Yunque National Forest 2016, 46).

Our EIS review also identified key USDA policies and directives featuring resilience and related concepts, which provides understanding of guidance available for planners and others to conceptualize resilience for their work (see Table 1 below).

**Table 1 Key US Department of Agriculture policies and directives featuring resilience and related concepts (Timberlake et al. 2017)**

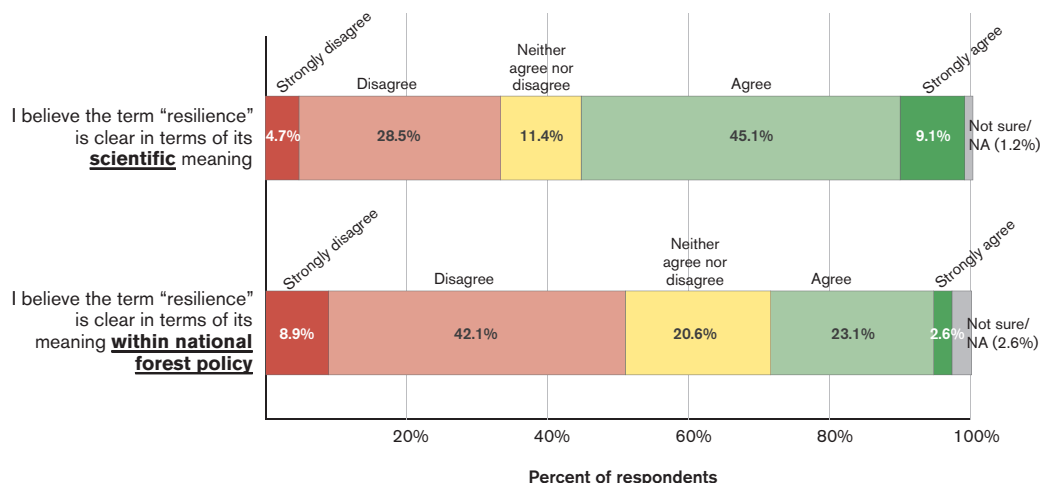
Agency policies and documents	Language related to resilience
Forest Service Manual (2016)	Chapter 2020, Ecosystem Restoration, directs the agency to reestablish and retain “ecological resilience of National Forest System lands and resources to achieve sustainable multiple use management and provide a broad range of ecosystem services.”
National Cohesive Wildland Fire Management Strategy (2014)	The strategy outlines three guiding nationwide goals, the first of which is to “restore and maintain resilient landscapes” (Wildland Fire Leadership Council 2014, 3).
USFS 2012 Planning Rule (2012)	Directs the national forest plan revision process and addresses eight key management needs, the first of which is to “emphasize restoration of natural resources to make our NFS lands more resilient to climate change, protect water resources, and improve forest health” (36 CFR §219, 21164). The rule requires land management plans ensure restoration and maintenance of “ecological integrity,” incorporating resilience into this definition (36 CFR §219.19). The rule also adopts language related to adaptation in the face of climate change and other stressors.
USDA Roadmap and Scorecard (2011)	Builds on the strategic framework and outlines response to climate change through a cycle of stages: Assess, Engage, and Manage. Forests must manage for “resilience, in ecosystems as well as in human communities, through adaptation, mitigation, and sustainable consumption” (U.S. Forest Service 2011, 4).
USDA Strategic Framework (2008)	Outlines seven broad goals for how the agency responds to climate change. One goal, Adaptation, seeks to “enhance the capacity of forests and grasslands to adapt to the environmental stresses of climate change and maintain ecosystem services ... [by] maintaining ecosystem resilience” (U.S. Forest Service 2008, 9).

Our survey of USFS employees found a similar lack of consensus around use of the term “resilience” within the context of national forest management, as well as a lack of clarity in how the term is defined



within the agency. Over 55% of respondents agreed the scientific definition of resilience was clear while only about 26% of respondents agreed the definition of resilience was clear within national forest policy. At the same time, nearly all (94%) of respondents believed it was important that the USFS have a clear definition of resilience. There was more consensus around the scientific definition than the agency definition of resilience, with the majority of respondents (>64%, n=275/428) selecting “adaptive resilience,” i.e., the ability to adapt to disturbances while retaining core system components (see Figure 3 below and Figure 5 in Coughlan et al., 2020).

**Figure 3 Respondent perspectives on the clarity of the term “resilience” within science and national forest policy**



With regard to adopting resilience in planning, in all three studied forests, during the revision process, agency planners implemented changes intended to support the agency’s ability to achieve resilient landscape outcomes, mainly focused on opportunities to restore fire to ecosystems as well as departures from traditional output-oriented planning and management. Specific examples of this are detailed in Abrams et al., 2020 and Timberlake et al., 2020.

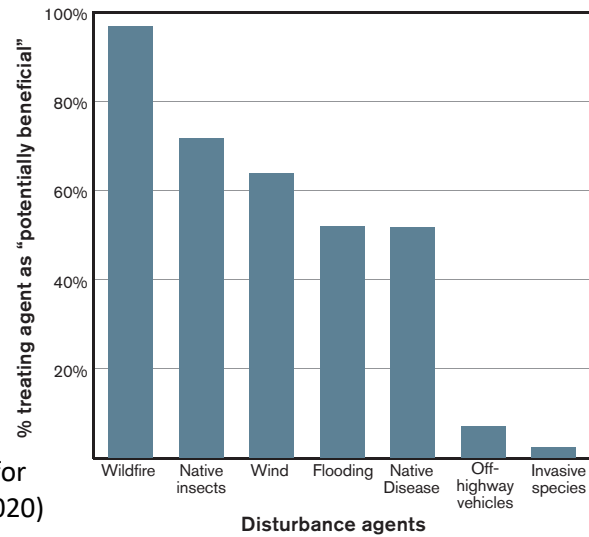
Across our review of EISs, case studies and survey we also found that individuals in the agency frequently conceptualized resilience and disturbance together. Many disturbance agents—from prevalent concerns such as wildfire, insects, and forest disease, to less obvious agents such as wind events and flooding— can possibly have positive effects on ecosystems and on some of their component species. Phenomena that appear to be destructive can be harnessed for management objectives, such as the establishment of stand diversity and the creation of a mosaic of land types.

Within the three studied national forests, meanings and understandings of resilience varied across the ecosystems and disturbance agents present on each forest. Interviewees in the case studies widely agreed on the meaning of resilience in historically frequent-fire systems such as longleaf pine on the FMNF and ponderosa pine on the KNF, which were considered to benefit from the reintroduction of fire (wild or prescribed), with forest stand treatments as needed to reduce fuel loads (Abrams et al., 2020). However, in other common forest systems, particularly the spruce-fir forests that dominate the RGNF, the concept of resilience was less clear. The historic disturbance regime in these high-elevation forests is more complicated than frequent fire systems, and further complicated by a spruce beetle outbreak

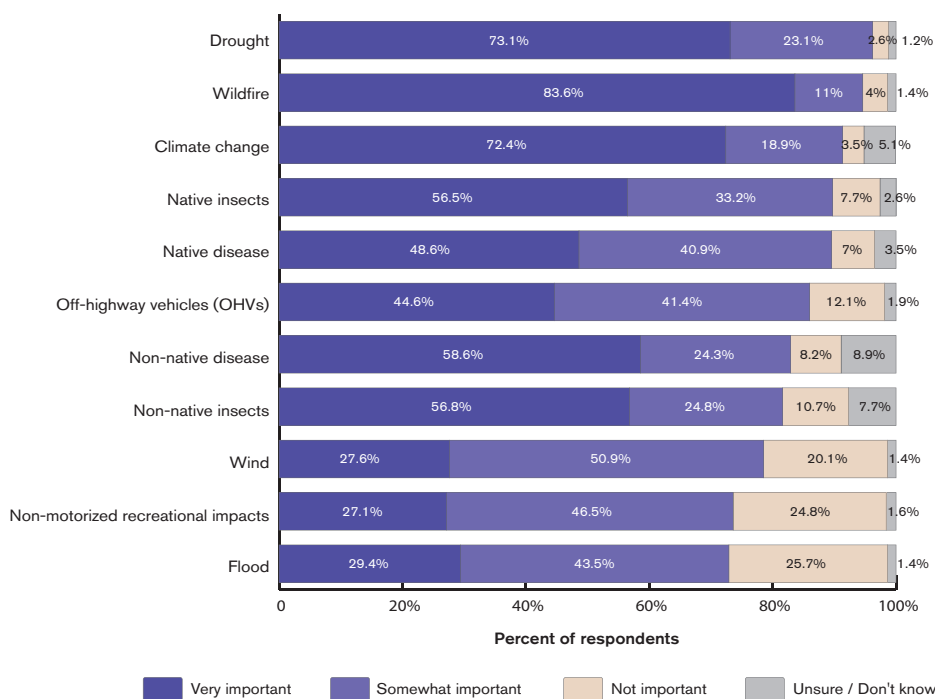
recently killing the RGNF’s mature trees. In the review of EIS documents, disturbances were frequently classified as potentially beneficial in EIS analysis, especially wildfire and native insects (see Chart 1 on right, from Abrams and Chapin, 2020).

Similarly, in the survey, respondents indicated that all of the disturbance agents listed in the survey had an influence on the resilience of their individual management units, although they varied across different disturbances and regions. Respondents rated each of the 11 disturbance agents we asked about as important to resilience in their management units, with the percentage of respondents selecting “somewhat important” to “very important” ranging from 73% for flood to 96% for drought (see Figure 6, below, from Coughlan et al. 2020) with an overall average of approximately 85%.

**Chart 1** How often disturbances were classified as potentially beneficial in EIS analysis



**Figure 6** Respondent evaluation of the importance of disturbance agents on resilience within their management unit



## Objective 2. Opportunities and institutional barriers to resilience planning

Our research identified opportunities and challenges around the definitions and conceptualizations of resilience, instituting adaptive and flexible management, capacity issues in managing for resilient landscapes, constraining and enabling policies and practices for resilience, and broader political and institutional considerations. Having clear and agreed upon definitions for resilience was a key finding of

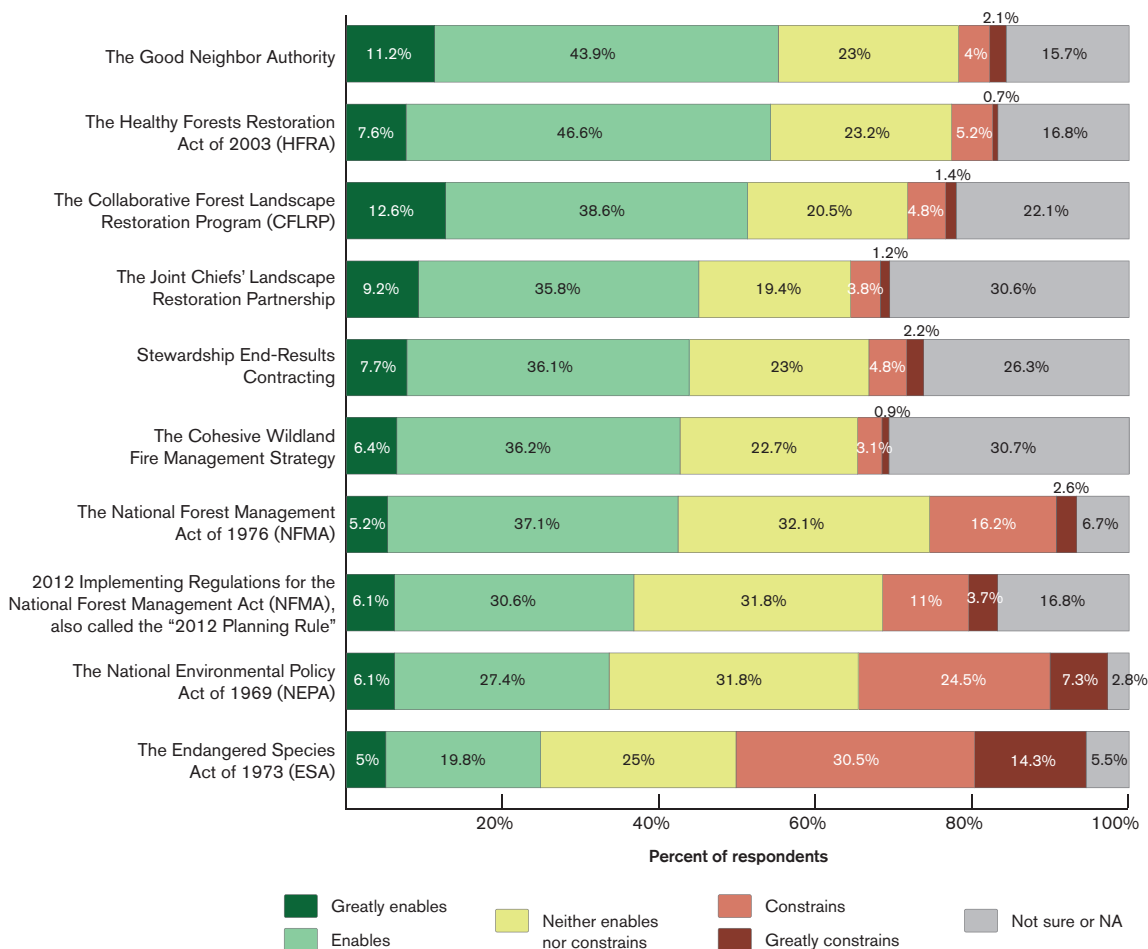
our work, as described in the Quick Guide (Abrams and Chapin 2020) and throughout the recommendations below and project publications. The lack of consensus around use of the term “resilience” within the context of national forest management, as well as a lack of clarity in how the term is defined within the agency was evident in all stages of our research, as noted above.

Adaptive and flexible management was an opportunity identified by interviewees, many of whom agreed that adaptive management was needed to achieve resilient landscape outcomes, but that it faced many challenges. Namely, interviewees identified agency National Environmental Policy Act (NEPA) procedures, risk aversion in the USFS, and the expectation of clear plan commitments among some external partners and advocacy organizations all as dynamics challenging adaptive management within the USFS.

Both agency and non-agency interviewees across all three cases recognized trust-including building and maintaining trust in relationships-as a key variable for transitioning from rigid to adaptive planning and management. External partners mainly expressed trust and confidence in the current suite of USFS managers, however some were concerned about the potential for future managers to take advantage of a highly flexible plan to manage in ways not broadly supported by the community.

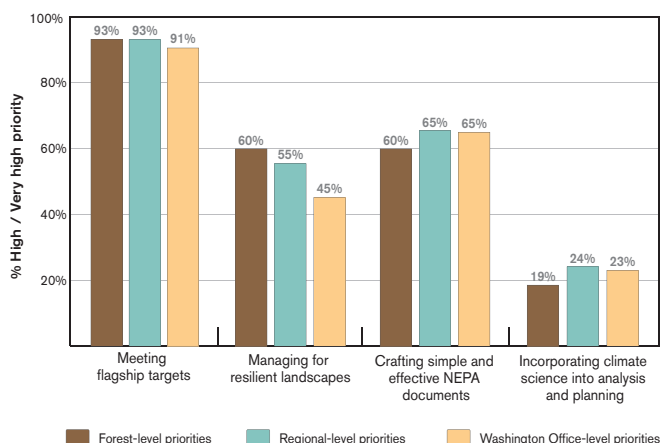
In the survey, land managers perceived recent policies over the last few decades as more enabling than constraining for the ability to manage for resilience, while they perceived many common practices and concerns as constraining (see Figure 8 below, from Coughlan et al., 2020). The only listed policy that respondents rated as more constraining than enabling was the Endangered Species Act: 45% felt that it constrained their ability to achieve resilient outcomes while only 25% felt it helped enable those outcomes. Most respondents identified the Good Neighbor Authority (55%), 2003 Healthy Forest Restoration Act (54%), and Collaborative Landscape Restoration Program (51%) as enabling the ability to manage for resilience. Unlike the response to policies, respondents indicated that many common practices and concerns constrained the ability to manage for resilient outcomes at their management units. Nearly all respondents identified budget limitations for implementation and planning as constraints to managing for resilient outcomes on their units. Approximately 70% of respondents thought that public pressure to minimize disturbance and the threat of lawsuits from public interest groups constrained unit-level resilient outcomes. The expectation to meet timber targets was also seen as a constraint. Partnerships with scientists and collaboration with non-USFS stakeholders were most often perceived as enabling the agency’s ability to manage for resilient outcomes.

**Figure 8 Respondent perspectives on the extent to which different policies enable or constrain their unit's ability to manage for resilient outcomes**



In the survey, unlike the response to policies, respondents indicated that many common practices and concerns constrained the ability to manage for resilient outcomes at their management units, which aligns with other research on USFS challenges. The very real and immediate challenges posed by a lack of funding, resources, tools, trained staff and other capacity has a direct impact on implementation in federal land management implementation.

**Figure 10 Respondent perceptions of Forest Service priorities at forest, regional, and national levels**



In other constraints, most survey respondents thought that public pressure to minimize disturbance and the threat of lawsuits from public interest groups constrained unit-level resilient outcomes. When we asked about respondent perceptions of USFS priorities at different levels within the agency, we

found that nearly all respondents (>90%) thought that across forest-, region- and Washington Office-levels, meeting flagship targets (board feet sold and acres treated for hazardous fuels) were high agency priorities (see Figure 10, below). Approximately 65% thought crafting simple and effective NEPA documents was another high priority for agency leadership.

Survey respondents also identified opportunities enabling the agency's ability to manage for resilient outcomes, namely partnerships with scientists and collaboration with non-USFS stakeholders.

### **Objective 3. Resources to help fire, fuels, and forest planners incorporate resilience into planning processes at multiple scales and implications for practice**

Through all stages of this research we gathered information to help create summary documents, resources and other information to help fire, fuels, and forest planners incorporate resilience into planning processes at multiple scales. This is described in further detail in Abrams and Chapin's Quick Guide (2020) and further sections of this report, here we provide some key points.

Based on our review of agency mandates and resources, we propose suggestions for how to plan for resilience, with an emphasis on partnerships drawing on scientists, managers across different agencies, and local communities, and breaking up resilience planning into specific steps or phases makes the challenge less daunting and more understandable (Textbox 5 below, from Timberlake et al., 2017).

#### **Textbox 5: Key recommendations**

##### **There are several key elements of the *process* for resilience planning**

- Partnerships with government and academic scientists, other government entities, and stakeholders help provide capacity and a diversity of perspectives to resilience planning.
- Resilience planning should occur over several steps.
- Monitoring and revisiting assumptions helps managers respond to uncertainty; resilience planning is a form of adaptive management.

##### **When resilience planning, managers should consider several *substantive* elements**

- Defining the system in question should occur early in the process. What are key ecosystem types, species, stressors, human uses?
- While defining the system, it is important to consider the geographic scale. Geographic scale may correspond to jurisdictional boundaries (e.g., a national forest) or an ecoregion.
- The timeframe (or temporal scale) also matters.
- What are the relevant stressors? Will climate change affect these stressors? Managers are accustomed to managing for disturbances, such as wildfires and insect outbreaks. However, climate change may impact these disturbances. How can resilience help respond to disturbances?
- Understanding the impacts of future climate change is a complicated process with several different decision points. Partnering with scientists may be important in order to identify the most appropriate climate scenarios to inform resilience planning, and other community and NGO partners may provide important resources and perspectives.



Through all of our project research methods, we have identified both challenges and possible solutions to the successful operationalization of resilience within the USFS. We developed a Quick Guide that offers lessons learned from these analyses along with tips for practitioners looking to put resilience into action (Abrams and Chapin, 2020). Examples of best practices are described in the form of **five key steps for improving the incorporation of resilience in national forest planning and management** (see Figure 1, below).

**Figure 1 Overview of the key steps for improving the incorporation of resilience in national forest planning and management**



We developed a series of considerations for planners when considering incorporating resilience into their work, including, for example:

- After an agreed-upon definition of resilience is reached, participants should determine what, exactly, they are hoping to make resilient, against what disturbance(s), and in what social context. In other words, *resilience of what, to what, for whom?*
- Since the concept of resilience is founded on the understanding that social and ecological systems tend to be dynamic rather than stable, planning and management are most likely to succeed when they make room for disturbance, change, and even surprise.
- Many disturbance agents—from prevalent concerns such as wildfire, insects, and forest disease, to less obvious agents such as wind events and flooding— can possibly have positive effects on ecosystems and on some of their component species, and might be harnessed for management objectives. Our research found that USFS planners broadly recognize that fire can have potential benefits in many systems, and other disturbance agents such as native insects, native diseases, flooding, and wind are often described as having potential benefits. Some suggested elements of planning for constructive change include discussing past histories of suppressing disturbances and describing the potential benefits and impacts of various disturbance agents.
- Creative solutions for capacity include approaches such as: partnering with science providers, taking advantage of existing data sources, enlisting citizen scientists, and establishing external advisory boards.

The ability to characterize patterns, processes, and interactions for particular systems and model future outcomes is key for land managers, but agencies have struggled to fill science gaps in the face of budgetary and capacity shortages. In spite of this, some national forest managers have demonstrated innovative ways to successfully expand their scientific and monitoring capacity despite constraints, key examples of which, from the case studies, are in Table 5 (below, from Abrams et al., 2020).

**Table 5 Successful practices related to planning for resilient landscapes**

Successful practice	FMNF	KNF	RGNF
Improved fire management strategies	Incorporation of a two-zone fire management system and prescribed burning system to expand fire management options	Flexible fire management strategies to manage naturally ignited fires for resource benefit in conjunction with an effective prescribed fire program	Incorporation of a two-zone fire management system to expand fire management options
Increased partnerships and science support	Science support from NGOs, state organizations, and USFS scientists	Science support from local and regional NGOs and universities	Science support from USFS scientists and universities
	Partnering with non-USFS entities on project implementation (such as prescribed fire)	Working with tribes to integrate place-based knowledge and holistic management approaches	Use of existing databases and citizen science to build flexible monitoring program
Increased local engagement and outreach	Efforts to focus on relationship building in growing urban interface around fire management	Long-term investments of building trust and constructive relations with interested publics and organizations	Ongoing engagement with public and stakeholders throughout planning
Intentional intra-agency practices	Clear leadership intent to support agency morale and trust for transitioning to adaptive approaches	Clear leadership intent to support agency morale and trust for transitioning to adaptive approaches	Consultation with neighboring national forests on planning approaches
	Deliberate shift from a fast-growing tree species to a greater emphasis on ecologically valuable species		Clear leadership intent to support agency morale and trust for transitioning to adaptive approaches

### Science Delivery activities:

#### **Northwest Fire Science Consortium-led dissemination**

Project PIs are part of the leadership team of the JFSP-funded Northwest Fire Science Consortium (NWFSC) that began providing science and knowledge dissemination in 2012. The publications created throughout this project have been shared with and disseminated by the Northwest Fire Science Consortium in newsletters and social media posts and are available on the Consortium's website. In addition, the NWFSC also helped co-host a webinar on results of this project, expanding the reach of the findings beyond the geographies where our case studies were based.

#### **Southwest Fire Science Consortium and the Forest Stewards Guild**

We also worked with the Southwest Fire Science Consortium (SWFSC) and the Forest Stewards Guild (PI Evans is director of the Forest Stewards Guild) during this project to increase engagement in the southwest in particular, including helping the project team identify and connect with key personnel for the Kaibab National Forest case study. The SWFSC also hosted a webinar focused on key results from all three of the elements of this research ([Resilience in National Forest Planning](#)).

#### **Project webpage and targeted science delivery emails**

We created a permanent project webpage on the Ecosystem Workforce Program's website that outlines the objectives of this project and provides access to the deliverables we created. We have advertised this webpage along with products through each of the fire exchanges noted above as well as through:

- A writeup on the project and results featured in Ecosystem Workforce Program's Fall 2020

- quarterly listserv email
- An email sent to research participants that wished to be informed of results (approximately 45 people). Throughout our case study interviews, we asked interviewees if they wished to be informed of results of the study and kept a confidential list of emails for those that were interested. We sent these recipients an email outlining the deliverables available on the page and offering resources if they had any questions.
- We also engaged with USFS personnel directly on project results, particularly through two invited presentations to USDA Forest Service agency meetings, one for the National Planning and Public Engagement group, and one for the Regional Planning monthly meeting. These meetings, along with question and answer and discussion sessions at the project results webinar and conferences all provided opportunities to provide targeted responses to specific questions people raised.

### **Non-targeted dissemination**

We also shared our project deliverables and the project webpage on the front page of the Ecosystem Workforce Program's website under "in the news" and on our Twitter account.

### **Conference presentations**

We presented on this research project and its findings and implications through seven academic conference presentations and two invited presentations at USDA Forest Service Regional and National Planning meetings. Each of these efforts is outlined in the deliverables section.

## **VI. Conclusions (key findings) and implications for management**

Ensuring the resilience of national forest lands is critical for ensuring the resilience of society at large, across the nation and for social, ecological, economic and cultural purposes. This research met all the study objectives (as described in the prior section and below), and contributed to the limited understanding and literature quantifying and detailing where and how resilience is incorporated within the agency planning processes and documents.

When taken together, our research demonstrates how USFS planners and managers are attempting to incorporate the ambiguous concept of resilience into a complex managerial and policy context which is riddled with potentially contradictory pressures and expectations. National forest managers perceive resilience as a concept and disturbance agents differently across the National Forest System, which is not surprising and is broadly aligned with prior scholarship on the topic. However, we also identified novel dimensions of resilience-oriented forest management related to the influence of policies, pressures, and agency priorities, as described in this and the prior section.

We found that despite the Forest Service's establishment of an agency-wide definition of "resilience" in 2014, there is still a lack of clarity within the agency regarding its meaning for national forest management. This discrepancy may be related to the persistence of policies, procedures, and performance metrics that emphasize measurable outputs rather than promoting the more integrative and adaptive values associated with the resilience concept. For example, in our national survey of national forest planners, respondents overall indicated that leadership is not prioritizing resilience-based management at the same level as flagship targets such as timber. Tradeoffs exist on many management units between short-term priorities related to meeting flagship targets (timber and acres treated) and longer-term priorities related to restoring landscape resilience. The agency should consider developing a

broader set of performance metrics that help to reconcile this tension and better support management for long-term forest resilience.

Respondents perceived that most of the major policies driving national forest planning and management were not significant constraints; rather, budget limitations and public perceptions and pressures were the greatest constraints on their management unit's ability to manage for resilience. Partnerships and collaboration were seen as most enabling their ability to manage for resilient outcomes, but these were not necessarily sufficient to overcome shrinking budgets and uncertainty created by diverse public and stakeholder views on appropriate forest management. This suggests that the agency may need to allocate more resources toward the restoration and maintenance of resilient forest conditions even as it continues to invest in partnerships and collaborative processes.

The broad agreement we found from interviewees and survey respondents that adaptive management is needed in order to achieve resilient landscape outcomes, is key to understanding the implications of this research. Related to this, agency and non-agency interviewees across all three cases recognized trust as a key variable for transitioning from inflexible to adaptive planning and management. The capacity to manage for resilient landscapes is a key challenge, similar to research on other agency challenges or obstacles. USFS budgetary and staffing capacity for planning, implementing, and monitoring as well as science and technical capacity are central to informing resilience-oriented projects. Planners noted that partnerships with USFS and NGO scientists greatly improved scientific and technical capacity in planning efforts, and many national forest managers expressed the desire that non-agency partners would continue to take active roles in collecting new monitoring data, adding needed capacity and support for restoring and managing forests under the influences of climate change. Our work suggests that the agency should consider ways to foster and deepen ongoing engagement with partners and a robust systems of monitoring, to build and maintain trust and to address real and ongoing capacity issues within the agency.

A challenge that was identified throughout our research was the tension between managing for long-term resilient outcomes and managing to meet short-term performance metrics (such as timber sold and acres treated for hazardous fuels). Misalignments between incentive structures and adaptive management can negatively affect relationships with external partners, but often cannot be changed by the district- and forest-level staff who are most aware of external partner relationships. We underscore the importance of recognizing the limitations these misalignments pose and recommend the agency be transparent with partners and stakeholders about tradeoffs and these scalar issues up front.

A promising avenue for achieving resilient outcomes are policies that help planners and managers engage in collaboration, build partnerships, and incorporate high-quality scientific information, all of which will require continued political and budgetary support (Coughlan et al., 2020). Some of our research described here suggests that the current policy mix and leadership direction at different scales might not be well structured to support management of national forestlands for resilience. More focus on the newer suite of optional tool-oriented policies and emphasis on collaborations and partnerships all might better enable management of resilient landscapes.

#### **Other elements for land managers:**

Our research also suggests that to transition from conventional output-oriented forest management to management informed by concepts of resilience, the following elements are beneficial to land managers:

- Conceptual clarity on the meaning and application of resilience.
- A clear legal and policy framework promoting and prioritizing landscape resilience.
- Incentives and flexibility for managers to practice adaptive management.

- Access to relevant, site-specific information to inform planning and management.
- Capacity to achieve resilient landscape outcomes.

**Other implications for practice and opportunities for direct implementation by end users** are described in the quick guide described under Objective 3 in the prior section. The Quick Guide (Abrams and Chapin, 2020) was created to identify both challenges and possible solutions to successful operationalization of resilience for managers. This resulted in the aforementioned five key steps for resilience operationalization. The tips and best management practices in this guide can be used in concert with other resources and guides (referenced in the quick guide) to help put resilience thinking into practice.

#### **Future Research:**

This research project promoted consideration of many other questions and areas worthy of further inquiry for the broader research community. This research should be of interest not only to wildfire social science scholars, but more broadly to those exploring resilience and public lands management. In many cases, the findings our research yielded align to a large degree with other work on federal lands management scholarship. For example, limited capacity for staff and resources (funding, skilled employees) have an overarching influence on what work can be accomplished, and can exacerbate preexisting challenges staff face in accomplishing their work. Some questions and future directions to explore include:

- What tensions and tradeoffs does the Forest Service experience in trying to managing resilience to multiple social and ecological stressors simultaneously?
- How can careful consideration of the tradeoffs between achieving short-term performance metrics and longer-term forest resilience inform future forest policy reforms?
- What resources and capacity for monitoring do managers and partners need to be able to better learn together and build trust in the knowledge generated?
- How can improved policy and budgetary support help the agency achieve resilient landscape outcomes?
- What do natural resource agencies need to develop the policy direction, incentive systems, and institutional direction to prioritize managing for resilience over other competing objectives to achieve resilient landscape outcomes?
- How can social support for adaptive management be increased to achieve resilient landscape outcomes, through relationships with external partners such as communities, NGOs, local governments, and higher education institutions?



## VIII. Deliverables Cross-Walk Table

See deliverables list for full citations of all deliverables listed below.

Proposed deliverables	Delivered	Status
<b>From original proposal:</b>		
3 Refereed journal articles	<ol style="list-style-type: none"> <li>1. Abrams, 2019. Published in <i>Forest Policy and Economics</i>.</li> <li>2. Timberlake et al., 2020. Published in <i>Journal of Environmental Planning and Management</i>.</li> <li>3. Abrams et al., 2020. Submitted to <i>Environmental Management</i>.</li> </ol>	<ol style="list-style-type: none"> <li>1. Complete, published</li> <li>2. Complete, published</li> <li>3. Complete, revise and resubmit as needed</li> </ol>
3 EWP Working Papers	<ol style="list-style-type: none"> <li>1. EWP Working Paper #77, 2017</li> <li>2. EWP Working Paper #100, 2020</li> <li>3. EWP Working Paper #101, 2020</li> </ol>	Complete
1 Resilience planning “best practices” document	Incorporating Resilience in National Forest Planning and Management: A Quick Guide	Complete
Research briefs and briefing papers on key findings	<ol style="list-style-type: none"> <li>1. EWP Briefing Paper #87, 2020</li> <li>2. EWP Briefing Paper #88, 2020</li> </ol>	Complete
3 Conference presentations	<ol style="list-style-type: none"> <li>1. Essen et al., 2018. 15th International Wildland Fire Safety Summit and 5th Human Dimensions of Wildfire Conference. Asheville, NC.</li> <li>2. Timberlake et al., 2018. International Symposium on Society and Resource Management. Snowbird, UT.</li> <li>3. Abrams et al., 2018. The Fire Continuum Conference. Missoula, MT.</li> </ol>	Complete
Webinars with: <ul style="list-style-type: none"> <li>▪ Fire Science Consortia</li> <li>▪ Nationwide for managers, planners, and stakeholders</li> </ul>	<ol style="list-style-type: none"> <li>1. “Resilience in national forest planning.” SW Fire Science Consortium webinar, Sept. 9, 2020.</li> <li>2. “Resilience in national forest planning.” Presentation to USDA Forest Service Regional Planning meeting, Sept. 15, 2020</li> <li>3. “Resilience in national forest planning.” Presentation to USDA Forest Service National Planning and Public Engagement meeting, September 30, 2020</li> </ol>	Complete
<b>From extension request:</b>		
1 Refereed journal article	1. Coughlan et al., submitted 12/28/2020 to <i>Land Use Policy</i>	Completed, revise and resubmit as needed
<b>Additional deliverables created:</b>		
Refereed journal article	Chapin et al., submitted 12/21/2020 to <i>Society and Natural Resources</i>	Completed, revise and resubmit as needed
Conference presentation	Abrams et al., 2020. International Symposium on Society and Resource Management, Virtual Conference.	Completed
Conference presentation	Abrams et al., 2020. Ecological Society of America, Virtual Conference	Completed
Conference presentation	Chapin et al., 2020. North American Congress for Conservation Biology, Virtual Conference.	Completed
MS Thesis	Jim Chapin MS Thesis on resilience in EIS analysis	In prep
Project website	<a href="http://ewp.uoregon.edu/ForestResilience">http://ewp.uoregon.edu/ForestResilience</a>	Completed
Dissemination of deliverables	<ol style="list-style-type: none"> <li>1. Announcement of results via the NW Fire Science Consortium</li> <li>2. Email announcing final publications to research participants</li> <li>3. Email announcing results to EWP network of partners and collaborators</li> </ol>	Complete

## VIII. Sources Cited

Abrams, J., M. Knapp, T. Paveglio, A. Ellison, C. Moseley, M. Nielsen-Pincus, and M. Carroll. 2015. Reenvisioning community-wildfire relations in the U.S. West as adaptive governance. *Ecology and Society* 20(3): 34.

Benson, M.H. and A. Garmestani. 2011. Can we manage for resilience? The integration of resilience thinking into natural resource management in the United States. *Environmental Management* 48: 392-399.

Bone, C., C. Moseley, K. Vinyeta, and R.P. Bixler. In review. Employing resilience in the United States Forest Service. Submitted to Land Use Policy.

Green, O.O., A.S. Garmestani, C.R. Allen, L.H. Gunderson, J.B. Ruhl, C.A. Arnold, N.A.J. Graham, B. Cosens, D.G. Angeler, B.C. Chaffin, and C.S. Holling. 2015. Barriers and bridges to the integration of social-ecological resilience and law. *Frontiers in Ecology and the Environment* 13(6): 332-337.

Hamilton, B.A. 2015. 2014 Quadrennial Fire Review Final Report. Washington, D.C.: USDA Forest Service Fire and Aviation Management and Department of the Interior Office of Wildland Fire.  
Moseley, C. and S. Charnley. 2014. Understanding micro-processes of institutionalization: Stewardship contracting and national forest management. *Policy Sciences* 47: 69-98.

Schultz, C. and M. Nie. 2012. Decision-making triggers, adaptive management and natural resources law and planning. *Natural Resources Journal* 52: 443.

Walker, B. and D. Salt. 2006. *Resilience Thinking: Sustaining Ecosystems and People in a Changing World*. Washington, D.C.: Island Press.

## X. Deliverables

### **Final report:**

Integrating Social and Ecological Resilience into Forest Management Planning. Final Report for JFSP Project Number 16-3-01-10, compiled by H. Huber-Stearns and A. Ellison.

### **Website:**

Ecosystem Workforce Program. "Resilience in National Forest Planning." University of Oregon. <http://ewp.uoregon.edu/ForestResilience>.

### **Conference Presentations/Webinars**

Essen, M., A.L. Velez, A. Schmidt, D. Williams, H. Minkowitz, B. Nowell, M. Nielsen-Pincus, and J. Abrams. "Crossing boundaries of wildfire management in the US," 15<sup>th</sup> International Wildland Fire Safety Summit and 5<sup>th</sup> Human Dimensions of Wildfire Conference, Asheville, NC, December 10-14, 2018.

Timberlake, T., J. Abrams, A. Evans, M. Fernández-Giménez, and C. Schultz. "Making sense of resilience in federal forest management: A case study of the Kaibab National Forest." International Symposium on Society and Resource Management, Snowbird, UT, June 17-22, 2018.

Abrams, J., A. Evans, M. Fernandez-Gimenez, C. Schultz, and T. Timberlake. "Planning for resilience in federal forest management: Analysis of the state of practice." The Fire Continuum Conference, Missoula, MT, May 20-24, 2018.

Abrams, J., J. Chapin, T. Timberlake, S.M. Greiner, C. Schultz, M. Coughlan, H. Huber-Stearns, and A. Evans. "New paradigm or new packaging? Resilience and U.S. National Forest Management." International Symposium on Society and Resource Management, Virtual Conference, July 20, 2020.

Abrams, J., T. Timberlake, S.M. Greiner, J. Chapin, A. Evans, C. Schultz, M. Coughlan, H. Huber-Stearns, and M. Fernandez-Gimenez. "Operationalizing resilience in U.S. national forest management: A multi-methods analysis." Ecological Society of America, Virtual Conference, August 3-6, 2020.

Chapin, J., J. Abrams, C. Schultz, T. Timberlake, A. Evans, and M. Fernandez-Gimenez. "Implementation of social-ecological resilience on U.S. national forestlands: A quantitative analysis." North American Congress for Conservation Biology, Virtual Conference, July 27-31, 2020.

Abrams, J., T. Timberlake, M. Greiner, J. Chapin, A. Evans, C. Schultz, M. Coughlan, H. Huber-Stearns, A. Ellison, and M. Fernandez-Gimenez. "Resilience in national forest planning." Webinar, Southwest Fire Science Consortium, September 9, 2020.

### **Invited Papers/Presentations**

Abrams, J. "Resilience in national forest planning." Presentation to USDA Forest Service Regional Planning monthly meeting, September 15, 2020.

Abrams, J. "Resilience in national forest planning." Presentation to USDA Forest Service National Planning and Public Engagement meeting, September 30, 2020.

### **Publications in Print/in Press**

#### ***Journal articles (refereed)***

Abrams, J. 2019. The emergence of network governance in U.S. national forest administration: Causal factors and propositions for future research. *Forest Policy and Economics* 106: 101977. [doi.org/10.1016/j.forpol.2019.101977](https://doi.org/10.1016/j.forpol.2019.101977)

Thomas J. Timberlake , Courtney A. Schultz , Alexander Evans & Jesse B. Abrams (2020): Working on institutions while planning for forest resilience: a case study of public land management in the United States, *Journal of Environmental Planning and Management*. [DOI:10.1080/09640568.2020.1817730](https://doi.org/10.1080/09640568.2020.1817730)

#### ***Journal articles under review (refereed)***

Abrams, J, S.M. Greiner, C. Schultz, A. Evans, and H. Huber-Stearns. Can forest managers plan for resilient landscapes? Lessons from the United States national forest plan revision process. Revised and resubmitted 12/27/2020 to *Environmental Management*.

Chapin, J., J. Abrams, T. Timberlake, C. Schultz, A. Evans, and M. Fernandez-Gimenez. Operationalizing resilience on U.S. national forestlands: A quantitative analysis of Environmental Impact Statements. Submitted 12/21/2020 to *Society and Natural Resources*.

Coughlan, MA., Abrams, J., Huber-Stearns, H. Institutional and Policy Pressures on Resilient Forests: Perspectives from National Forest Planners and Managers. Submitted 12/29/2020 to *Land Use Policy*.

**Technical reports:**

Abrams, Jesse, Michelle Greiner, Thomas Timberlake, Courtney Schultz, Alexander Evans, and Heidi Huber-Stearns. 2020. Planning and Managing for Resilience: Lessons from National Forest Plan Revisions. Working Paper 100. Eugene, OR: Ecosystem Workforce Program, Institute for a Sustainable Environment. [http://ewp.uoregon.edu/sites/ewp.uoregon.edu/files/WP\\_100.pdf](http://ewp.uoregon.edu/sites/ewp.uoregon.edu/files/WP_100.pdf).

Coughlan, Michael R., Autumn Ellison, Jesse Abrams, and Heidi Huber-Stearns. 2020. Land Manager Experiences with Resilience in National Forest Management and Planning. Working Paper 101. Eugene, OR: Ecosystem Workforce Program, Institute for a Sustainable Environment. [http://ewp.uoregon.edu/sites/ewp.uoregon.edu/files/WP\\_101.pdf](http://ewp.uoregon.edu/sites/ewp.uoregon.edu/files/WP_101.pdf).

Timberlake, Thomas, Courtney Schultz, and Jesse Abrams. 2017. Resilience in Land Management Planning: Policy Mandates, Approaches, and Resources. Working Paper 77. Eugene, OR: Ecosystem Workforce Program, Institute for a Sustainable Environment. [http://ewp.uoregon.edu/sites/ewp.uoregon.edu/files/WP\\_77.pdf](http://ewp.uoregon.edu/sites/ewp.uoregon.edu/files/WP_77.pdf).

**Briefing papers:**

Abrams, Jesse, Michelle Greiner, Thomas Timberlake, Courtney Schultz, Alexander Evans, and Heidi Huber-Stearns. 2020. Planning and Managing for Resilience: Lessons from National Forest Plan Revisions. Briefing Paper 87. Eugene, OR: Ecosystem Workforce Program, Institute for a Sustainable Environment. [http://ewp.uoregon.edu/sites/ewp.uoregon.edu/files/BP\\_87.pdf](http://ewp.uoregon.edu/sites/ewp.uoregon.edu/files/BP_87.pdf).

Coughlan, Michael R., Autumn Ellison, Jesse Abrams, and Heidi Huber-Stearns. 2020. Land Manager Experiences with Resilience in National Forest Management and Planning. Briefing Paper 88. Eugene, OR: Ecosystem Workforce Program, Institute for a Sustainable Environment. [http://ewp.uoregon.edu/sites/ewp.uoregon.edu/files/BP\\_88.pdf](http://ewp.uoregon.edu/sites/ewp.uoregon.edu/files/BP_88.pdf).

**Other Quick Guide for Land Managers:**

Chapin, James and Jesse Abrams. 2020. Incorporating Resilience in National Forest Planning and Management: An EWP Quick Guide. Eugene, OR: Ecosystem Workforce Program, Institute for a Sustainable Environment. Ecosystem Workforce Program Quick Guide, Summer 2020. [http://ewp.uoregon.edu/sites/ewp.uoregon.edu/files/QuickGuide\\_IncorporatingResilience.pdf](http://ewp.uoregon.edu/sites/ewp.uoregon.edu/files/QuickGuide_IncorporatingResilience.pdf)

**Graduate Thesis:**

Chapin, James. Thesis in progress for completion in May 2021, to be submitted in partial fulfillment for masters degree. University of Georgia, Athens, GA.

## Appendix C: Metadata

Metadata for this project consisted of two sets of metadata, both of which have been archived with the University of Oregon's Scholar's Bank (<https://scholarsbank.uoregon.edu/xmlui/>), and the readme file has been uploaded with the JFSP final report. The specific links to the metadata are provided in the sections below. Scholars' Bank is the open access repository for the intellectual work of faculty, students, and staff at the University of Oregon, and certain partner institution collections. Open access journals, student projects, theses and dissertations, pre- and post-print articles, instructional resources, and university archival material are all candidates for deposit. Scholar's Bank is the appropriate repository for the metadata from this project, given the format and data type, which is not appropriate for a more quantitative data repository.

### 1. Environmental Impact Statement Database

**Metadata location:** <https://doi.org/10.7910/DVN/KCA9M5>

**Authors:** Abrams, Jesse; Warnell School of Forestry and Natural Resources, Savannah River Ecology Laboratory, University of Georgia, Athens, Georgia. ORCID: 0000-0002-1937-4606  
Chapin, James; Warnell School of Forestry and Natural Resources, University of Georgia, Athens, Georgia  
Timberlake, Thomas; USDA Forest Service, Region 2, Lakewood, Colorado  
Huber-Stearns, Heidi; Institute for Sustainable Environment, University of Oregon, Eugene, Oregon.  
ORCID: 0000-0002-8663-4471

**Contact:** Heidi Huber-Stearns, [hhuber@uoregon.edu](mailto:hhuber@uoregon.edu)

**Title:** EIS\_Database\_JFSP16-3-01-10

**Date:** 09-29-2020

**Abstract:** The EIS database represents coded content of Environmental Impact Statements (EIS) produced by the USDA Forest Service for the years 2007-2016.

**Keywords:** NEPA, Resilience, Disturbance, Forest management, Forest Policy

**Details:** The data cover the USDA Forest Service lands in all US states and territories. Data are provided in .csv format with codebook. The dataset contains Environmental Impact Statement project details, geographic information, and content codes pertaining to variables associated with the definition and application of resilience, disturbance agents considered, policies and practices applied, and descriptive variables. EIS documents included in this dataset were obtained through documents available on the USDA Forest Service and Environmental Protection Agency websites. Automated content analysis was used to identify EIS documents from years 2007 to 2016 that included the terms "resilience," "resilient," or "resiliency" at least five times. The database represents a stratified random sample of those identified documents, which were later coded manually according to a coding guide. These data were collected and analyzed under the Joint Fire Science Program (grant #16-3-01-10) funded project entitled "Integrating Social and Ecological Resilience into Forest Management Planning". For more information please visit <https://www.firescience.gov>.



## 2. Land Managers Experience with Resilience

**Metadata location:** <https://doi.org/10.7910/DVN/XF7M5M>

**Authors:** Abrams, Jesse; Warnell School of Forestry and Natural Resources, Savannah River Ecology Laboratory, University of Georgia, Athens, Georgia. ORCID: 0000-0002-1937-4606  
Coughlan, Michael; Institute for Sustainable Environment, University of Oregon, Eugene, Oregon. ORCID: 0000-0001-6071-1873  
Huber-Stearns, Heidi; Institute for Sustainable Environment, University of Oregon, Eugene, Oregon. ORCID: 0000-0002-8663-4471

**Contact:** Heidi Huber-Stearns, [hhuber@uoregon.edu](mailto:hhuber@uoregon.edu)

**Title:** Land\_Manager Experiences with Resilience, Survey Responses

**Date:** 09-29-2020

**Abstract:** The Land Manager Experience with Resilience dataset consists of internet-based survey responses from USDA Forest Service planners and managers which investigated beliefs and perceptions surrounding the meaning of resilience and the implementation of resilience-based forest management on national forest management units.

**Keywords:** Resilience, Disturbance, Forest management, Forest Policy, Agency priorities

**Details:** The data consists of de-identified survey responses from 428 respondents recruited from a list of 2,213 USDA Forest Service planners listed as "Responsible Officials" and "ID Team" members on National Forest Environmental Impact Statements. The data are available as .csv and .sav (IBM SPSS Statistics 26 Data Document). The survey was administered using Qualtrics Survey software and distributed via email through the use of an anonymous link from January to April 2020. Including metadata, there are 81 columns. Responses are likert-scale and multiple choice formats. These data were collected and analyzed under Joint Fire Science Program (grant #16-3-01-10) funded project entitled "Integrating Social and Ecological Resilience into Forest Management Planning". For more information please visit <https://www.firescience.gov>.